ADDITIONAL INFORMATION ON GLOBAL NUCLEAR ENERGY PARTNERSHIP FACILITIES

Advanced Fuel Cycle Facility

On its GNEP website (www.gnep.energy.gov/gnepProliferationResistantRecycling.html), DOE describes the Advanced Fuel Cycle Facility (AFCF) as the third component of its integrated spent fuel recycling capability and DOE says it plans to design and direct an AFCF, as a modern state-of-the-art laboratory designed to serve fuel research needs for the next 50 years. It would use modular, flexible construction techniques with near-term priority given to the fabrication and qualification of fuels for an advanced fast reactor. The facility will test separations processes on fast reactor spent nuclear fuel and fabricate fast reactor transmutation fuel for irradiation in an ABR.

The AFCF is planned as a pilot-scale facility, with a nominal capacity of around 25 metric tons of heavy metal (MTHM) (28 tons)/yr. The facility would test processes on fast reactor Spent Nuclear Fuel (SNF) and fabricate fast reactor transmutation fuel for irradiation in an Advanced Burner Reactor (ABR). There would probably be a small amount of interim storage onsite. The AFCF would likely develop and test the uranium- extraction (UREX) process and its variants. Some portions of the Consolidated Fuel Treatment Center (CFTC) may be similar to the AFCF, perhaps at the sub-module or individual component-scale. The staff plans to visit the U.S. Department of Energy (DOE) laboratories, in fiscal year (FY) 2007, to understand the technology development, to better comprehend how it may be applied at the commercial-scale CFTC, and associated safety requirements. The staff will participate in periodic technical exchanges with DOE and the involved laboratories and will review and comment on selected DOE documents pertinent to design and operation of facilities and processes. Also, the staff will attend meetings and present progress updates to the Advisory Committee on Nuclear Waste, and submit progress reports, as directed in Staff Requirements Memorandum (SRM)-SECY-06-0066. The AFCF is not intended for commercial use, and will likely be located at an existing DOE laboratory.

NRC does not have general regulatory authority over this type of DOE facility. NRC has legal authority to license commercial facilities and only those DOE facilities that fall within the scope of section 202 of the Energy Reorganization Act of 1974.[1] Based on the staff's preliminary discussions with DOE, it is anticipated that DOE will request that NRC provide technical support, ensuring that the construction and operation of the AFCF are consistent with NRC's safety and safeguards requirements.

[1] If the GNEP facilities are DOE controlled or DOE contractor operated facilities, then 1) the ABR may qualify under section 202(1) or (2) provided that it is "operated as part of the power generation facilities of an electric utility system, or when operated in any other manner for the purpose of demonstrating the suitability for commercial application of such a reactor" and 2) the CFTC may qualify under section 202(5) provided the facility is "under a contract with and for the account of the Department of Energy that is utilized for the express purpose of fabricating mixed plutonium-uranium oxide nuclear reactor fuel for use in a commercial nuclear reactor licensed under such Act other than any such facility that is utilized for research, development, demonstration, testing, or analysis purposes."

CFTC

Under the DOE industry-focused approach, the CFTC is to be planned as the commercial- scale version of the AFCF, with a nominal annual capacity of 2500 metric tons of heavy metal (MTHM)(2800 tons)/year (i.e., approximately equal to the annual SNF discharge rate from all existing nuclear reactors in the U.S.). In its CFTC Request for Expression of Interest (EOI), DOE only identified "... some rough parameters for considering the ultimate characteristics of a CFTC facility for GNEP." However, DOE stated that the CFTC must comply with all environmental protection laws and regulations and "...must be capable of being licensed under U.S. Nuclear Regulatory Commission (NRC) regulations applicable to demonstration operations on privately owned land regardless of where the demonstration is sited."

DOE has told industry that it would like the CFTC to be designed to perform several key functions, including: (1) separating reusable uranium and transuranic elements from spent light-water reactor (LWR) fuel, for use in fabricating fast reactor driver fuel; (2) separating LWR and fast reactor SNF into their usable components and fabricating transmutation fuel from those components; and (3) ensuring that the facility designs meet the U.S. standards for safeguards and security. Of particular note is that DOE envisions that it will plan and design, partnering with industry, a large-scale CFTC, with either auxiliary, presumably small-scale, demonstration functions to augment the CFTC, or it will build a separate transmutation fuel separations and fabrication facility, to perform further research and development on transmutation fuels technologies. This suggests multiple designs, possible design certifications, and possibly multiple license amendments.

At this time, NRC staff concludes that the CFTC is not yet clearly defined. DOE acknowledges many existing technical challenges. There are many CFTC technology challenges that may affect the success of implementing a closed fuel cycle.

The CFTC is intended to be a fuel reprocessing and fabrication facility. It is anticipated that DOE, partnered with industry, will use an aqueous (e.g., UREX+) separation technology, to separate spent light water reactor (LWR) fuel into its uranium, transuranic (TRU), and fission product components. The staff expects that pyroprocessing may be used for recycling fuel from the ABR after more DOE research and development. The recovered uranium and TRU radionuclides will be used in fabricating fast reactor driver fuel and TRU transmutation fuel.

A commercial reprocessing facility is defined as a "production facility," under the Atomic Energy Act of 1954, as amended, and could be licensed under Part 50, "Domestic Licensing of Production and Utilization Facilities." Licensing the CFTC under Part 50, however, would present a formidable challenge because 1) it would be the first reprocessing facility licensed in the past 40 years and 2) essentially all the technical standards, requirements, and acceptance criteria in Part 50 are now specific to LWRs, which have significantly different safety and environmental considerations than a spent fuel reprocessing facility. Therefore, development of new regulations will likely be required to efficiently and effectively license the CFTC reprocessing activities, particularly if more than one commercial CFTC were to be licensed. In addition, the fuel fabrication portion of the CFTC would be currently licensed under 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material." This would further complicate the CFTC licensing because multiply licenses would be necessary for one facility. However, Section 161h of the Atomic Energy Act provides the Commission with the flexibility to use a single licensing action to cover all the needed authorizations.

ABR

Under DOE's industry-focused approach, the ABR would be developed as a commercial-scale fast reactor that would be used to transmute fuel and consume transuranic (TRU) elements within the fuel, generate electricity, and support implementation of the GNEP. DOE has focused on the sodium-cooled fast reactor because it believes it to be the most mature technology available now, to serve its purpose. However, in DOE's ABR Request for EOI, DOE said it was open to other technologies, if the technology were mature or ready to be deployed.

DOE envisions the ABR as a fast neutron spectrum reactor, to consume TRU elements within the fuel, and generate electricity. DOE expects that the ABR will be qualified with conventional fast reactor fuel, followed by modification, so that it would eventually be used for recycling fast reactor transmutation fuel. In its ABR Request for EOI, DOE only identified "some rough parameters" for considering the ultimate characteristics of an ABR for GNEP. As with the CFTC Request for EOI, DOE clearly stated, in its ABR Request for EOI, that the ABR must comply with all environmental protection laws and regulations and must be capable of being licensed and operated under NRC regulations applicable to operations on privately owned land, regardless of where the ABR is sited. Also, DOE noted that to support timely implementation supportive of GNEP goals, the ABR system should be capable of commercial deployment, as early as possible. The ABR is intended to be a fast neutron reactor capable of transmuting and consuming ("burning" by fission) TRU elements while generating electricity. DOE has focused on sodium- cooled fast reactors (SFRs), because it believes the technology to be the most mature.

The ABR would initially use fuel that would be similar to the fuel used in previous fast reactors in the United States. Later, after more research and testing is conducted, the TRU elements (plutonium, neptunium, americium, and curium) could be fabricated into fuel for the ABR.

As reflected in DOE's August 2006 request for EOIs, DOE has not yet committed to a specific separation technology, or to a specific reactor type for implementation in GNEP. Most of the GNEP literature in the public domain and DOE reports to Congress have focused on aqueous separation technologies, especially the uranium-extraction (UREX+) based separation processes, and sodium-cooled fast reactors. DOE believes these technologies are currently the most mature technologies. DOE has emphasized that it will consider different technologies and now plans to make decisions, in part, based on input from industry as discussed in DOE's Notice of Intent to Prepare a PEIS for GNEP (72 Fed. Reg. 331, January 4, 2007). Although the scale of the facilities and technology selection remain fluid at this point, for the purposes of this paper, the staff assumes that UREX and sodium-cooled fast reactor technologies are the most likely candidates that will be deployed under DOE's accelerated industry-focused GNEP approach.

Uncertainties Related to Technologies

First, the technologies have only been demonstrated at the laboratory or bench scale. Second, uncertainties such as scaling up the chemical separations for the recycle process, or fabricating and qualifying the transmutation fuel for the ABR exists and need to be evaluated and resolved, as necessary. Furthermore, to add to the uncertainty, in its CFTC Request for EOI, DOE gave industry only "examples" of technical characteristics of the CFTC. Potentially, the CFTC could have interim SNF and waste storage, a reprocessing/separations area, new fuel fabrication,

and a waste solidification facility. These may be areas within the same large facility, adjacent/joined facilities, or discrete facilities on the same site. Most likely, the interim SNF storage facility would be constructed and operated first, perhaps 5-10 years ahead of the other facilities. DOE might arrange funding or otherwise contract to have the facilities built, but the facilities would be regulated by NRC. The facilities may or may not be located on DOE sites. In addition, Waste Incidental to Reprocessing determinations would have to be made for certain waste streams arising from these facilities.